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SONIC BOOMS AND SLEEP: AFFECT CHANGE AS A FUNCTION OF AGE

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16. Abstract

This study concerned the measurement of mood changes resulting from simulated sonic booms occurring during sleep. Subjects from three age groups (21 to 26, 40 to 45, and 60 to 72 years old) spent 21 consecutive nights in a sleeping room equipped for sonic-boom simulation. During the sixth through seventeenth nights, simulated sonic booms of 1.0 psf "outdoors" overpressure level (.1 psf measured inside the sleeping rooms) were presented hourly throughout each night. As the measure of mood, the subjects completed a composite mood adjective checklist in the evening before retiring and in the morning after waking on each of the 21 days. No change in moods attributable to the occurrence of simulated sonic booms was found. Substantial effects relating to the age of subjects, irrespective of boom presentations, were obtained. It was concluded that simulated sonic booms of such low intensity were unlikely to have adverse consequences on the mood states of most individuals.

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I. Introduction.

The National Research Council of the National Academy of Sciences has reported that in order to better understand the effects of sonic booms on humans, research in a number of different areas is urgently needed.[5] It was indicated that it is particularly important to know more about the responses of sleeping individuals to sonic booms, since any interruption, or change in depth of sleep (as measured by the electroencephalograph) caused by booms might have a considerable detrimental effect on some, if not most, individuals. It was also felt that such effects would be most pronounced for middle-aged or elderly persons. Of particular concern was the determination of the extent to which sonic booms occurring during sleep result in behavioral changes, psychological distress, or excessive fatigue.

The focus of the present study was on the measurement of psychological distress resulting from sonic booms occurring during sleep. The Composite Mood Adjective Checklist (CMACL),[6] a measure of mood states, was employed as the index of such distress. It is an 80-item inventory which provides an overall index of degree of positive affect, as well as scores for 15 individual mood factors such as anxiety, aggression, friendliness, and so on. The CMACL is suitable for the repeated administrations required in such a project, and has been shown to be sensitive to changes in mood resulting from sleep deprivation.[4]

It was the purpose of this study, then, to determine to what extent CMACL scores are influenced by exposure to simulated sonic booms during sleep, and to measure this effect in terms of the age group, i.e., young-adult, middle-aged, or elderly, to which an individual belongs. A second purpose was to determine to what extent the effects of repeated sonic-boom exposure during sleep are cumulative with respect to affective states. It was felt that initially, any disruption might be "subclinical," but that the effects might summate across sessions to then become observable after several evenings of sonic-boom exposure.

II. Method.

A. *Subjects.* There were eight paid subjects in each of the following three age groups: young-adults (21 to 26 years old), middle-aged (40 to 45 years old), and elderly (60 to 72 years old). The subjects were in good health and had no deficit in auditory functioning in the lower frequency ranges. Of the young-adult group, five were students and three held full-time jobs. In the middle-aged group, seven were fully employed and one was a student. In the elderly group, only one was employed full-time and the remaining seven were retirees.

B. *Procedure.* The project,[2] of which this study was a part, measured physiological states, and complex performance, in addition to the assessment of mood states as herein described. Two subjects at a time spent 21 consecutive nights in a sleeping room equipped for sonic-boom simulation and electrophysiological monitoring. Both subjects in each pair were from the same age group. All subjects arrived for each session at 2000 hours, went to bed at 2200 hours, and were awakened at 0620 hours. Before retiring, both mood and performance measures were taken prior to attachment of electrodes for recording during sleep. In the mornings, electrodes were removed, and the mood and performance measures were repeated. For the first five nights (Phase I), subjects were permitted to adapt to the sleeping quarters and no booms were presented. On nights 6 through 17 (Phase II), the subjects were exposed to hourly sonic booms starting at 2300 hours and continuing until 0600 hours the following morning. If either subject was awake at the time of a scheduled boom, the boom was delayed up to 10 minutes if

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necessary. Each boom had an intensity of .1 psf measured inside the sleeping room and 1 psf measured in the pressure chamber adjacent to the sleeping room. The rise time of the boom, as recorded in the sleeping quarters, was 12 msec and had a duration of approximately 284 msecs. The last four nights of the sequence were designated recovery sessions (Phase III) during which no booms were presented. During the day, subjects went about their normal activities.

The CMACL was administered each night and morning of the study. The CMACL scales have been more completely described elsewhere[6,9]; however, briefly it consists of 80 adjectives (e.g., happy, angry, apprehensive, etc.) which are rated from "not at all" to "definitely" applicable on a nine-point scale. For the overall index of affect on each administration, all adjectives indicating positive feelings are given scores according to increasing ratings of applicability while negative-affect adjectives are scored inversely. Each protocol was also scored for the 15 individual factors listed by Malmstrom.[6]

III. Results.

A. *Overall Index.* The mean overall index was highest (most positive degree of affect) during Phase I, and then declined across Phases II and III (Table 1). Each consecutive phase had a significantly lower mean overall index than the preceding phase ($p<.05$).* This decline was primarily associated with affect change in the young-adult group, as the affect level of the middle-aged and elderly groups was fairly constant across phases. This differential effect as a function of age was reflected in the significant Age by Phase interaction ($p<.001$); in the analysis of simple effects, only the youngest group showed a significant decline in affect level ($p<.001$). It should also be noted that the elderly group tended to have higher scores than the other two age groups throughout the experiment ($p<.05$); however, the differences between the elderly and young-adult groups were significant ($p<.05$) only during Phases II and III, and between the elderly and middle-aged groups only during Phase II ($p<.05$). There were no significant differences between the young-adult and middle-aged groups within any experimental phase.

* Detailed results of all statistical analyses are presented in the appendix.

TABLE 1.—Mean Overall-Index Scores for Young-Adult, Middle-Aged, and Elderly Subjects for Evening and Morning Assessments During Each Experimental Phase

Group	Time of Assessment	Phase I (Pre-Boom)	Phase II (Boom)	Phase III (Post-Boom)
	Evening	7.09	6.83	6.26
Young-adult	Morning	7.03	6.82	6.54
	Overall	7.06	6.82	6.40
	Evening	7.04	6.79	6.84
Middle-aged	Morning	6.90	6.82	6.93
	Overall	6.97	6.80	6.88
	Evening	7.45	7.63	7.47
Elderly	Morning	7.39	7.46	7.44
	Overall	7.42	7.55	7.45

There was a tendency for the relative degree of positive affect between evening and morning assessments to vary as a function of phases ($p<.05$). This result was primarily due to subjects in the young-adult and middle-aged groups reporting significantly ($p<.05$) more positive affect in the morning than in the evening during Phase III (Table 1).

There were relatively few findings of significance with respect to trends in the overall index across days within each experimental phase. Only Phase I contained a significant finding relating to Days; there was a modest Age by Days interaction ($p<.05$). For young adults, there was a general declining trend across Days 1 through 4, then there was a substantial increase ($p<.05$) in positive affect on Day 5 relative to Day 4 (Table 2). There was no trend for affect change in the middle-aged group, while the overall index on Day 1 from the elderly group was significantly lower than the remaining days ($p<.05$). No other significant results relating to days within phases were noted.

B. *Mood Factors.* Six mood factors showed a general declining trend in positive affect across experimental phases ($p<.05$ or better), while only one factor, Sleepy, indicated an improvement ($p<.01$) in mood as the experiment progressed (Table 3). Moreover, only on the Concentration factor was the change in scores from phase to phase consistent across age groups. There was a significant Age by Phase interaction on the remaining six factors, as well as on five additional factors ($p<.05$ or better). As detailed in Table 5, the young-adult group showed

TABLE 2.—Mean Overall-Index Scores for the Young-Adult, Middle-Aged, and Elderly Groups on Each Day of Phase I (Pre-Boom)

Group	Day 1	Day 2	Day 3	Day 4	Day 5
Young-adult	7.22	7.12	6.97	6.79	7.19
Middle-aged	6.79	6.92	7.03	7.00	7.10
Elderly	7.09	7.44	7.58	7.50	7.50

decreasing positive affect across phases on nine factors ($p<.05$ or better). For the middle-aged group, there was relatively little change in mood across phases on 10 of the factors; a decrease in positive affect on the three factors Friendly, Nonchalance, and Social Affection ($p<.05$ or better); and a reduction in negative feelings on the two factors of Sleepy ($p<.01$) and Fatigue ($p<.05$). As with the middle-aged group, the elderly group showed no change in affect across phases on most of the factors; however, on the four factors which did indicate change, only Vigor showed a decrease in positive affect ($p<.01$). Scores for the elderly group on the Sleepy, Anxiety, and Dizzy factors all shifted in the direction of increasing positive affect across phases ($p<.05$ or better).

There were five factors which had general age effects in addition to those described in the interactions with Phase and with Time of Assessment. On four of the factors, Concentration, Friendly, Nonchalance, and Social Affection, the elderly group had more positive affect scores ($p<.05$ or better) than either the young-adult or the middle-aged groups (Table 3). The young-adult and middle-aged groups differed from each other only on the Nonchalance factor with the middle-aged group having the higher mean score ($p<.05$). The only factor on which the elderly group had a score indicating a higher degree of negative affect was on the Dizzy factor, but the difference was significant only between the elderly and young-adult groups ($p<.05$).

There were general differences between evening and morning mood assessments on only two factors, Surgency and Depression (Table 4). With respect to Surgency, subjects generally had higher scores in the evening than in the morning ($p<.05$). Scores for the Depression factor also were higher in the evening than morning ($p<.01$). This difference between assessments on the Depression factor was a result of the response tendencies of the young-adult group

TABLE 3.—Mean Mood Factor Scores for Young-Adult, Middle-Aged, and Elderly Subjects During Each Experimental Phase

Mood Factor	Group	Phase I (Pre-Boom)	Phase II (Boom)	Phase III (Post-Boom)
AACL[bc] (Zuckerman)	Young-adult	57.61	63.64	71.75
	Middle-aged	58.56	64.17	62.38
	Elderly	52.07	48.76	50.53
Agression	Young-adult	7.99	7.92	8.17
	Middle-aged	7.75	8.14	7.70
	Elderly	7.37	7.18	7.70
Anxiety[c]	Young-adult	10.55	11.41	12.59
	Middle-aged	11.47	12.13	11.86
	Elderly	12.67	10.93	11.01
Anxious	Young-adult	1.65	1.49	1.66
	Middle-aged	2.44	3.11	3.30
	Elderly	2.42	2.33	2.50
Concentration[ab]	Young-adult	39.31	34.77	30.53
	Middle-aged	40.84	39.23	38.27
	Elderly	60.44	59.44	58.22
Depression[c]	Young-adult	25.06	25.98	30.67
	Middle-aged	22.91	23.14	22.23
	Elderly	24.15	21.20	21.59
Distrust	Young-adult	3.55	3.52	4.20
	Middle-aged	4.77	4.35	4.47
	Elderly	4.88	4.85	4.67
Dizzy[ac]	Young-adult	4.21	4.18	5.34
	Middle-aged	4.93	4.61	4.84
	Elderly	7.60	6.61	6.64
Fatigue[c]	Young-adult	17.74	17.47	20.86
	Middle-aged	22.49	20.95	18.75
	Elderly	25.83	23.18	23.53
Friendly[abc]	Young-adult	13.74	12.30	10.14
	Middle-aged	16.04	13.07	14.00
	Elderly	20.42	20.24	20.05
Nonchalance[ac]	Young-adult	6.90	6.15	5.76
	Middle-aged	8.91	6.54	7.05
	Elderly	10.87	11.85	11.64
Sleepy[bc]	Young-adult	8.48	7.07	9.00
	Middle-aged	11.66	9.63	7.31
	Elderly	13.85	11.71	11.00
Social Affection[abc]	Young-adult	18.16	16.58	13.92
	Middle-aged	18.12	15.87	16.86
	Elderly	26.45	27.10	27.02
Surgency[bc]	Young-adult	23.66	19.95	15.92
	Middle-aged	21.85	19.95	21.22
	Elderly	26.62	25.35	23.77
Vigor[bc]	Young-adult	15.16	13.42	10.91
	Middle-aged	14.32	14.01	13.97
	Elderly	17.85	17.07	15.89

[a] Age effect was significant

[b] Phase effect was significant

[c] Age by Phase interaction was significant

only, as analysis of the significant Age by Time of Assessment interaction for this factor ($p<.01$) indicated that the middle-aged and elderly groups showed no difference between evening and morning scores on the Depression factor. The young-adult group w. s also found to have higher scores on the Friendly factor in the evenings than the mornings ($p<.01$), while the elderly group had higher scores in the mornings than in the evenings on the Dizzy factor ($p<.05$).

TABLE 4.—Evening and Morning Mean Ratings for Selected Mood Factors During Each Experimental Phase

Mood Factor	Time	Phase I (Pre-Boom)	Phase II (Boom)	Phase III (Post-Boom)
Anxious[b]	Evening	2.43	2.26	2.39
	Morning	1.99	2.36	2.57
Concentration[b]	Evening	48.05	44.55	41.72
	Morning	45.68	44.41	42.96
Depression[a]	Evening	24.62	23.58	25.79
	Morning	23.46	23.30	23.88
Friendly[b]	Evening	17.02	15.27	14.34
	Morning	16.44	15.14	15.11
Social Affection[b]	Evening	21.36	19.95	19.00
	Morning	20.47	19.74	19.94
Surgency[a]	Evening	25.07	22.15	20.11
	Morning	23.02	21.35	20.49

[a] Time of Assessment effect was significant

[b] Phase by Time of Assessment interaction was significant

During Phase I, scores tended to be more positive for the evening than morning assessments on the Concentration ($p<.05$) and Social Affection factors ($p<.05$). In contrast, scores on the Anxious factor (Table 4) tended to indicate more negative affect for the evening than the morning assessments ($p<.01$). During Phase II. there were no differences between evening and morning scores on any of the factors; however, in Phase III, the mean score on the Friendly factor was higher in the morning than in the evening ($p<.05$) as was also true for ratings on the Social Affection factor ($p<.05$).

IV. Discussion.

The findings clearly indicate that the low-intensity sonic booms used in this study had negligible effects upon sleep quality as reflected in affect states. The results from both the overall index and the 15 mood factors were consistent in every respect with this conclusion. If the sonic booms had been detrimental to sleep, affect indicators during Phase II should have shown a change toward less positive or more negative feelings relative to Phase I. This should then have been followed by a return to pre-boom affect levels during Phase III. The only group to show even a possible trend in this direction was the middle-aged group; however, the changes in affect across phases were not statistically significant. The elderly group had a pattern which was the inverse of the expected; however, like the middle-aged group, the changes were not significant. The young-adult group did have significantly reduced levels of positive affect during Phase II, but there was also a further reduction during Phase III. This suggests that it was not the occurrence of booms during Phase II which led to reduced positive affect in the young-adult group, but rather other characteristics of the experimental situation. This particular finding is consistent with the research of Datel, Gieseking, Engle, and Dougher[3] on moods in young military recruits, who found that evidence of dysphoria tended to increase as the recruits progressed through the first few weeks of basic training. Thus, it appears that young men react with increased negative affect to situations which are confining or restricting such as is the case with basic military training and with the present experiment.

The lack of significant effects associated with boom presentation is consistent with the findings from other aspects of the larger study of sonic-boom effects of which this survey was a part. For example, Chiles and West[1] found that performance levels in a complex multiple task performance battery were not influenced by sonic-boom presentation during sleep. Analyses of sleep profiles (EOC, EMG, and EEG records) indicated that while there was evidence of some slight responsiveness to the occurrence of booms, there were no significant changes in time spent in any sleep stage from non-boom to boom nights.[2] The results are also generally consistent with the findings from an exploratory study of the relationship of noise-disturbed sleep to post-sleep behavior.[5]

Further evidence that the sonic booms had little effect on sleep was provided by the Sleepy

factor. The significant decline in Sleepy scores from Phase I to Phases II and III is inconsistent with negative boom effects. It seems likely that this finding was a result of the subjects adapting their sleeping pattern to the new surroundings, strange beds, and experimental procedures which they encountered upon entering the experiment.

The finding that the elderly group generally reported a more positive degree of affect than the other two groups may be related to the "Hawthorne" effect[7] often noted in industry. The older participants in this study were mostly retired, and no longer involved in a day-to-day occupational activity. Thus, they may have lacked the activity, attention, and social contact which are usually associated with employment. Participation in the experiment may have met some of these needs, and so resulted in an overall increase in positive feelings for these individuals.

The evening-morning difference in affect obtained for the young-adult and middle-aged groups during Phase III was unexpected. Previous research has indicated that subjects usually report more pleasant moods in the evenings than in mornings.[10] In this case it may be that the reactions of the subjects in these groups to participation in the experiment may have changed substantially as the experiment progressed. Thus, as subjects approached the conclusion of the experiment, they may have had some negative reactions to the regimentation, the reduction and/or restriction in activities, and the inconveniences (e.g., electrode attachment) associated with the experiment. Coming to the experiment in the evening then meant return to these conditions, while upon arising in the morning they could look forward to being away from the experiment during the day; hence, their more positive feelings in the morning during Phase III.

In sum, there was no evidence in this study to support the notion that low-intensity simulated sonic booms (1.0 psf "outdoor" measurement) occurring during sleep will adversely influence the affect states of individuals exposed to such stimuli. The minimal intensity and frequency of booms required to produce negative effects on moods remains to be determined.

APPENDIX

Significant results (.05 level or better) from analyses of variance for overall index and each of the 15 mood factors of the Composite Mood Adjective Checklist.

A. Overall Index: Age—Phase—Time of Assessment ANOVA.

1. Age—F (2,21) = 3.51, $p < .05$ (no significant differences between means according to multiple comparison tests*)
2. Phase—F (2,42) = 15.63, $p < .001$
   Phase I > ($p < .05$) Phase II > ($p < .05$) Phase III
3. Age X Phase—F (4,42) = 14.40, $p < .001$
   Simple effects across Phases.
   Young-adult—F (2,42) = 40.43, $p < .001$
   Phase I > ($p < .01$) Phase II > ($p < .01$) Phase III
   Middle-aged—non-significant (N.S.)
   Elderly—N.S.
4. Phase X Time of Assessment—F (2,42) = 3.84, $p < .05$
   Simple effects across Time of Assessment.
   Phase I—N.S.
   Phase II—N.S.
   Phase III—F (1,63) = 2.22, $p < .05$ (Morning > Evening)

B. Overall Index: Age—Days within Phase I—Time of Assessment ANOVA.

1. Age X Days—F (8,84) = 2.46, $p < .05$
   Simple effects across Days.
   Young-adult—F (4,84) = 2.65, $p < .05$
      Days 1, 2, 3, 5 > ($p < .05$) Day 4
      Days 1, 5 > ($p < .05$) Day 3
   Middle-aged—N.S.
   Elderly—F (4,84) = 3.05, $p < .05$
      Days 2, 3, 4, 5 > ($p < .05$) Day 1

C. Overall Index: Age—Days within Phase II—Time of Assessment ANOVA.

1. Age—F (2,21) = 3.73, $p < .05$
   No significant differences between means according to multiple comparison tests.
2. Age X Time of Assessment—F (2,21) = 4.43, $p < .05$
   No significant simple effects.

D. Overall Index: Age—Days within Phase III—Time of Assessment ANOVA.

1. Age—F (2,21) = 6.41, $p < .01$
   Elderly > ($p < .01$) Middle-aged = Young-adult
2. Time of Assessment—F (1,21) = 7.80, $p < .01$ (Morning > Evening)

3. Age X Time of Assessment—F (2,21) = 4.78, $p < .05$
   Simple effects across Time of Assessment.
   Young-adult—F (1,21) = 6.89, $p < .01$ (Morning>Evening)
   Middle-aged—N.S.
   Elderly—N.S.

E. AACL (Zuckerman) Factor: Age—Phase—Time of Assessment ANOVA.**

1. Phase—F (2,42) = 8.40, $p < .001$
   Phase II = Phase III > ($p < .05$) Phase I

2. Age X Phase—F (4,42) = 7.27, $p < .001$
   Simple effects across Phases.
   Young-adult—F (2,42) = 18.85, $p < .01$
   Phase III > ($p < .01$) Phase II > ($p < .01$) Phase III
   Middle-aged—N.S.
   Elderly—N.S.

F. Aggression: No significant effects.

G. Anxiety

1. Age X Phase—F (4,22) = 5.17, $p < .001$
   Simple effects across Phases.
   Young-adult—F (2,42) = 5.28, $p < .01$
   Phase III > ($p < .05$) Phase II > ($p < .05$) Phase I
   Middle-aged—N.S.
   Elderly—F (2,42) = 4.95, $p < .05$
   Phase I > ($p < .05$) Phase III = Phase II

H. Anxious

1. Phase X Time of Assessment—F (2,42) = 7.43, $p < .01$
   Simple effects across Time of Assessment.
   Phase I—F (1,63) = 6.37, $p < .01$ (Morning>Evening)
   Phase II—N.S.
   Phase III—N.S.

I. Concentration

1. Age—F (2,21) = 10.02, $p < .001$
   Elderly > ($p < .01$) Middle-aged = Young-adult

2. Phase—F (2,42) = 6.85, $p < .01$
   Phase I = Phase II
   Phase II = Phase III
   Phase I > ($p < .01$) Phase III

3. Phase X Time of Assessment—F (2,42) = 4.05, $p < .05$
   Simple effects across Time of Assessment.
   Phase I—F (1,63) = 6.37, $p < .01$
   Phase II—N.S.
   Phase III—N.S.

J. Depression

1. Time of Assessment—F (1,21) = 15.43, $p < .001$ (Evening>Morning)

2. Age X Phase—F (4,42) = 5.89, $p < .01$
   Simple effects across Phases.

Young-adult—F (2,42) = 10.28, $p<.001$
Phase III > ($p<.05$) Phase II > ($p<.05$) Phase I
Middle-aged—N.S.
Elderly—N.S.

3. Age X Time of Assessment—F (2,21) = 10.49, $p<.001$
Simple effects across Time of Assessment.
Young-adult—F (2,42) = 34.78, $p<.001$ (Evening > Morning)
Middle-aged—N.S.
Elderly—N.S.

K. Distrust: No significant effects.

L. Dizzy

1. Age—F (2,21) = 3.61, $p<.05$
Elderly = Middle-aged
Middle-aged = Young-adult
Elderly > ($p<.05$) Young-adult

2. Age X Phase—F (4,42) = 3.46, $p<.05$
Simple effects across Phases.
Young-adult—F (2,42) = 4.73, $p<.05$
Phase III > ($p<.05$) Phase II = Phase I
Middle-aged—N.S.
Elderly—F (2,42) = 3.42, $p<.05$
Phase I > ($p<.05$) Phase II = Phase III

M. Fatigue

1. Age X Phase—F (4,42) = 3.43, $p<.05$
Simple effects across Phases.
Young-adult—F (2,42) = 3.28, $p<.05$
Phase III > ($p<.05$) Phase I = Phase II
Middle-aged—F (2,42) = 3.26, $p<.05$
Phase I = Phase II > ($p<.05$) Phase III
Elderly—N.S.

N. Friendly

1. Age—F (2,21) = 9.43, $p<.01$
Elderly > ($p<.01$) Middle-aged = Young-adult

2. Phase—F (2,42) = 15.21, $p<.001$
Phase I > ($p<.01$) Phase II = Phase III

3. Age X Phase—F (4,42) = 5.38, $p<.01$
Simple effects across Phases.
Young-adult—F (2,42) = 15.14, $p<.001$
Phase I > ($p<.01$) Phase II > ($p<.01$) Phase III
Middle-aged—F (2,42) = 10.66, $p<.001$
Phase I > ($p<.01$) Phase III > ($p<.05$) Phase II
Elderly—N.S.

4. Age X Time of Assessment—F (2,21) = 7.00, $p<.01$
Simple effects across Time of Assessment.
Young-adult—F (1,21) = 9.48, $p<.01$ (Morning > Evening)
Middle-aged—N.S.
Elderly—N.S.

5. Phase X Time of Assessment—$F\ (2,42) = 3.73$, $p < .05$
   Simple effects across Time of Assessment.
   - Phase I—N.S.
   - Phase II—N.S.
   - Phase III—$F\ (1,63) = 6.00$, $p < .05$ (Morning>Evening)

O. Nonchalance

1. Age—$F\ (2,21) = 5.76$, $p < .05$
   Elderly > ($p < .05$) Middle-aged = Young-adult
2. Age X Phase—$F\ (4,42) = 3.31$, $p < .05$
   Simple effects across Phases.
   - Young-adult—N.S.
   - Middle-aged—$F\ (2,42) = 6.35$, $p < .05$
     - Phase III > ($p < .05$) Phase II = Phase I
   - Elderly—N.S.

P. Sleepy

1. Phase—$F\ (2,42) = 7.54$, $p < .01$
   Phase I > ($p < .01$) Phase II = Phase III
2. Age X Phase—$F\ (4,42) = 3.24$, $p < .05$
   No significant simple effects.

Q. Social Affection

1. Age—$F\ (2,21) = 9.56$, $p < .01$
   Elderly > ($p < .05$) Middle-aged = Young-adult
2. Phase—$F\ (2,42) = 4.27$, $p < .05$
   Phase I > ($p < .05$) Phase II = Phase III
3. Age X Phase—$F\ (4,42) = 5.77$, $p < .01$
   Simple effects across Phases.
   - Young-adult—$F\ (2,42) = 11.68$, $p < .001$
     - Phase I > ($p < .01$) Phase II > ($p < .01$) Phase III
   - Middle-aged—$F\ (2,42) = 3.25$, $p < .05$
     - Phase I > ($p < .05$) Phase III = Phase II
   - Elderly—N.S.
4. Age X Time of Assessment—$F\ (2,21) = 3.76$, $p < .05$
   No significant simple effects.
5. Phase X Time of Assessment—$F\ (2,42) = 3.88$, $p < .05$
   Simple effects across Time of Assessment.
   - Phase I—$F\ (1,63) = 4.65$, $p < .05$ (Evening>Morning)
   - Phase II—N.S.
   - Phase III—$F\ (1,63 = 5.12$, $p < .05$ (Morning>Evening)

R. Surgency

1. Phase—$F\ (2,42) = 15.26$, $p < .001$
   Phase I > ($p < .01$) Phase II > ($p < .05$) Phase III
2. Age X Phase—$F\ (4,42) = 5.21$, $p < .01$
   Simple effects across Phases.
   - Young-adult—$F\ (2,42) = 21.43$, $p < .001$
     - Phase I > ($p < .01$) Phase II > ($p < .01$) Phase III
   - Middle-aged—N.S.
   - Elderly—N.S.

3. Time of Assessment—F (1,21) = 4.47, $p<.05$ (Evening>Morning)

S. Vigor

1. Phase—F (2,42) = 13.48, $p<.001$
   Phase I > ($p<.05$) Phase II > ($p<.01$) Phase III
2. Age X Phase—F (4,42) = 3.66, $p<.05$
   Simple effects across Phases.
   Young-adult—F (2,42) = 17.02, $p<.01$
   Phase I > ($p<.01$) Phase II > ($p<.01$) Phase III
   Middle-aged—N.S.
   Elderly—F (2,42) = 3.63, $p<.05$
   Phase I = Phase II > ($p<.01$) Phase III

* The Newman-Keuls test was used for multiple comparisons of ordered means.

** All analyses on the remaining mood factors are of this type.

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